



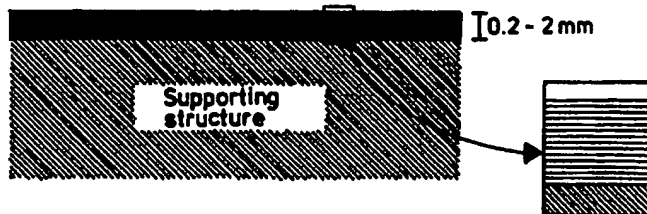
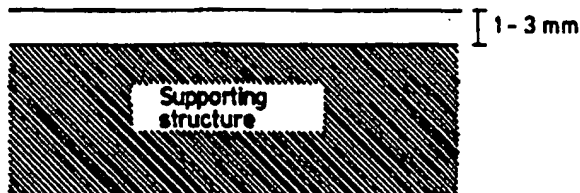
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>H05B 6/12</b>	<b>A1</b>	(11) International Publication Number: <b>WO 96/31995</b> (43) International Publication Date: 10 October 1996 (10.10.96)
<p>(21) International Application Number: PCT/DK96/00169</p> <p>(22) International Filing Date: 9 April 1996 (09.04.96)</p> <p>(30) Priority Data: 0424/95 7 April 1995 (07.04.95) DK</p> <p>(71) Applicant (for all designated States except US): AKTIEBO- LAGET ELECTROLUX [SE/SE]; Luxbacken 1, Lilla Es- singen, S-105 45 Stockholm (SE).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): DAHL, Jan, Erik [DK/DK]; Kongensgade 26 A, 2 th., DK-7000 Fredericia (DK). PEDERSEN, Thomas, Fich [DK/DK]; Dronningens- gade 45, 1, DK-7000 Fredericia (DK).</p> <p>(74) Agent: K. SKØTT-JENSEN PATENTINGENIØRER A/S; Lemmingvej 225, DK-8361 Hasselager (DK).</p>	<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: COOKING SURFACE

## (57) Abstract

A cooking surface has a thickness which is decided by a compromise between the highest efficiency, the lowest magnetic stray field, and the desired surface material. In the thickness range 0.05 to 0.2 mm the top layer consists of plasma sprayed hard ceramic such as alumina, possibly impregnated with poly-tetra-fluor-ethylene. In the thickness range 0.2 to 2 mm the top layer may consist of a glass fibre reinforced material possibly impregnated with poly-tetra-fluor-ethylene, possibly of a hardened quality, and in the thickness range 1.00 to 3.00 mm the top layer may consist of a vitroc ceramic or glass material. Scratch resistance and cleanability are combined with an elevated efficiency.

Impregnated plasma sprayingGlass fibre reinforced materialGlass/Glass-ceramic

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

Cooking surface.

The invention relates to a cooking surface for an induction heating cooker comprising a coil structure below the surface.

Flat and heat tolerant upper surfaces for cookers are well known, and their use in domestic kitchens is predominantly due to the ease with which one may move cooking utensils from one to the other cooking zone, the ease of cleaning, and the quick thermal response. However, most of these are made selfsupporting of a glass or vitroceramic material which have to be quite thick in order to withstand the dropping of cooking utensils. The differences in coefficient of expansion between the top plate of said glass or vitroceramic material and the supporting metal frame make the manufacture complex and the cleaning of the edges of the top plate is rather more difficult due to the need to allow expansion with respect to the surrounding frame.

The fairly thick glass or vitroceramic top plates which have become known in connection with radiative heating zones have been carried over into the area of induction heating, mainly because of the well-established manner of manufacture, provision with patterns and signs and because the material combines electrical insulation with strength. The hampering in energy transfer due to the spacing between the transmitting coil and the cooking utensil has been accepted in view of the other advantages.

In WO94/05137 a cooking plate concept is described which utilises an induction heating arrangement comprising a ring-shaped magnetic core structure made of magnetically conductive concrete. This structure is embedded in further concrete material, and the top surface may be either cast upon the fairly solid base or be made of possibly porous alumina (aluminium oxide ceramic) which demonstrates a high thermal insulation and abrasion resistance. This latter material would be applied by plasma spraying. It is hence non-

selfsupporting. However, this kind of top surface material, although thermally excellent, has shown certain disadvantages in practice. The inherent porosity makes the surface difficult to clean, although very strong detergents may be used, due to the chemical stability of alumina. The casting in place of a top layer of heat resistant concrete is efficient in the manufacturing process, but the finishing of such a surface and the sealing of the pores to permit cleaning are difficult tasks and the result may be destroyed by detergents. Hitherto it has been considered that a top layer should be as thin as possible for efficient power transport, in other words, the air gap should be minimized. Hence all endeavours in this field have worked towards this goal. The structure described above provides this possibility in a most efficient manner, but at the cost of a very massive construction.

There is hence a need for an improved surface which does not display these disadvantages, yet still provide the functionality of a construction of the type described in said PCT publication.

This is obtained by applying the realization that the heating of the top surface is due to two contributions: losses in the induction energy transmitter which is embedded in the base at some distance from the upper surface of the heat insulating layer and conduction of heat from the heated cooking vessel via the heat insulating layer to the induction energy transmitter. Said heating actually increases the losses of the induction energy transmitter. In fact, it has surprisingly turned out that for each combination of permeability in the bottom of the cooking vessel and the range of power handled by the cooking zone there is a range of thicknesses of the top layer which provides an optimum of efficiency in the transfer of power from the cooking zone to the cooking utensil. It has turned out that such thicknesses all fall in the same absolute

range which is in all cases below the 3 mm which is in general industrial use today. The improved structure is characteristic in that the thickness of the cooking surface is chosen between 0.05 mm and 3 mm, preferably  
5 between 0.2 and 2.5 mm. The preferential distance also affords a good performance as regards magnetic field leakage. The specific thickness to be used in any particular combination of coil structures, operational frequency and cooking vessel range may be determined by  
10 the skilled person without undue experimentation.

In an embodiment of the invention the surface is particular in that it extends unbroken over the totality of the coil structures at least to the edge area of the cooking area. This will give certain advantages as  
15 concerns cleaning by washing and may be supplemented by raised edges formed in the same material.

A further embodiment extends directly from the basic idea of the invention in that the top layer has a limited area, though larger than a coil structure, and  
20 may be removeable but flush with the surrounding surface when fitted. This makes it possible to fit surfaces above the coil structure which may be changed when eroded, permanently soiled, or perhaps not fitting with the internal decoration of the kitchen area, all in all  
25 making this highly technological product much more adaptable to living conditions than previously known cookers.

Further embodiments of the invention adapts the material of the top surface to the thickness determined  
30 for the particular construction, viz. for the thickness range 0.05 to 0.2 mm the top layer consists of plasma sprayed hard ceramic such as alumina, possibly impregnated with poly-tetra-fluor-ethylene, and for the thickness range 0.2 to 2 mm the top layer consists  
35 of a glass fibre reinforced material, possibly impregnated with poly-tetra-fluor-ethylene, possibly of a hardened quality. For the thickness range 1.00 to 3.00

mm the top layer consists of a vitroc ceramic or glass material. These materials each combine good wearing qualities with good cleaning properties, however according to the invention they are so thin that they  
5 would not be able to support themselves over large areas, let alone carry cooking vessels.

A further material which may advantageously be used in embodiments of the invention is an organically modified ceramic material.

10 In order to permit the user to determine which coil structure (which cooking zone) has most recently been active, a further advantageous embodiment incorporates reversible heat-modifiable pigments into the surface. This is now feasible and with a wide range  
15 of fairly low-temperature pigments because the invention provides for a high efficiency and hence low losses and reduced heating of the surface itself.

The specified thickness and the consequent reduction of heating losses according to the invention  
20 makes it possible to construct an induction heating cooker with several cooking zones which is totally self-supporting, i.e. without brackets between the edge frame members and yet lightweight. This is obtained by a construction which is particular in that one or several  
25 transmitter coil structure or structures is/are embedded in a polymer structure which is composed with a compartmentalised underside and a plane topside incorporating shallow wells for exchangeable top layers above each transmitter coil. A similar embodiment uses a  
30 light alloy in stead of a polymer, with the specific advantage that stray fields from the coil structures are shielded or short-circuited.

It has furthermore been realized that it is possible to obtain a thickness in the upper part of the  
35 range and yet retain the materials for the lower part of the thickness range with the advantages particular to those materials in that the surface consists of a

protective layer and a number of projections directed upwards from said layer, the height of the projections defining the thickness of the cooking surface. There is no limitation to the area and number of these  
5 projections, however in case only very few are used, they must not be so sharp as to scratch the cooking utensils. Obviously a minimum number of three supporting projections are needed for a pot. The particular  
10 advantage of this embodiment must be seen in the layer of air which creates heat insulation between the bottom of the cooking vessel and the coil structure embedded in the cooker.

The invention will be described in greater detail in the following with reference to the drawings, in  
15 which

Fig. 1 shows the general relationship between efficiency and thickness of the top layer,

Fig. 2 shows the general relationship between the magnetic B field surrounding a pot on an induction  
20 heating cooker in dependence of the thickness of the top layer,

Fig. 3 shows structures for top surfaces according to the invention, and

Fig. 4 shows a structure in which an air space  
25 supplies heat insulation between the bottom of a pot and the induction heating coil structure.

The basis for the invention resides in an observation that the practical efficiency (determined as output power versus input electrical power) of an  
30 induction heating cooker is dependent on the distance between the top of the coil structure including the core parts and has a maximum, the sharpness of which is dependent on the actual construction but with the general feature that thicknesses in the range 0.05 to 3  
35 mm cause a higher efficiency than thicknesses outside this range. A general curve displaying this relationship is shown on Fig. 1. Similarly it has been observed as

shown on Fig. 2 that the induction field B surrounding a pot on an induction heating coil structure increases with distance at relatively small distances. Hence there may surprisingly be found is a distance which is a  
5 suitable compromise between the highest efficiency, the lowest magnetic stray field, and the desired surface material.

In Fig. 3 is shown embodiments of the invention corresponding to the relevant thickness ranges. It is  
10 advantageous to let the surface layer extend outside the position of the induction coil structures, and hence the embodiments are generally shown to be supported by the "supporting structure".

In Fig. 4 is shown an embodiment which displays  
15 high strength and cleanability combined with the creation of an air gap which would normally only be obtained in an extremely porous structure. The supporting structure carries an upper surface made of alumina or similar composition which displays rounded  
20 projections, the number and distribution of which is dependent on the desired appearance of the top. The area of the individual projections may be selected according to e.g. the types of pot and may be ribs, possibly in a radial distribution.

## P A T E N T   C L A I M S

1. A cooking surface for an induction heating  
5 cooker comprising a coil structure below the surface,  
c h a r a c t e r i z e d   i n   that the thickness of  
the cooking surface is chosen between 0.05 mm and 3 mm,  
preferably between 0.2 and 2.5 mm measured between the  
10 top of the coil structure and the bottom of the cooking  
vessel.

2. A cooking surface according to claim 1,  
c h a r a c t e r i z e d   i n   that it extends  
unbroken over the totality of the coil structures at  
least until the edge of the cooking area.

15 3. A cooking surface according to claim 1,  
c h a r a c t e r i z e d   i n   that the top layer has  
a limited area, though larger than a coil structure, and  
may be removeable but flush with the surrounding surface  
when fitted.

20 4. A cooking surface according to claim 2 or 3,  
c h a r a c t e r i z e d   i n   that in the thickness  
range 0.05 to 0.2 mm the top layer consists of plasma  
sprayed hard ceramic such as alumina, possibly  
impregnated with poly-tetra-fluor-ethylene.

25 5. A cooking surface according to claim 2 or 3,  
c h a r a c t e r i z e d   i n   that in the thickness  
range 0.2 to 2 mm the top layer consists of a glass  
fibre reinforced material possibly impregnated with  
poly-tetra-fluor-ethylene, possibly of a hardened  
30 quality.

6. A cooking surface according to claim 2 or 3,  
c h a r a c t e r i z e d   i n   that in the thickness  
range 1.00 to 3.00 mm the top layer consists of a  
vitroceramic or glass material.

35 7. A cooking surface according to claim 1,  
c h a r a c t e r i z e d   i n   that the top layer  
consists of an organically modified ceramic material.

8. A cooking surface according to claim 1, characterized in that the top layer incorporates reversible heat-modifiable pigments.

9. A cooking surface according to claim 1 or 2, characterized in that shallow wells are provided for exchangeable top layers above each transmitter coil.

10. A cooking surface according to claims 1-3 and 9, characterized in that one or several transmitter coil structure or structures is/are embedded in a polymer structure which is composed with a compartmentalised underside and a plane topside incorporating shallow wells for exchangeable top layers above each transmitter coil.

11. A cooking surface according to claims 1-3 and 9, characterized in that the transmitter coils are fitted into a self-supporting light alloy structure with a plane topside incorporating shallow wells for exchangeable top layers above each transmitter coil.

12. A cooking surface according to any of the claims 1 to 7, characterized in that the surface consists of a protective layer and a number of projections directed upwards from said layer, the height of the projections defining the thickness of the cooking surface.

1/3

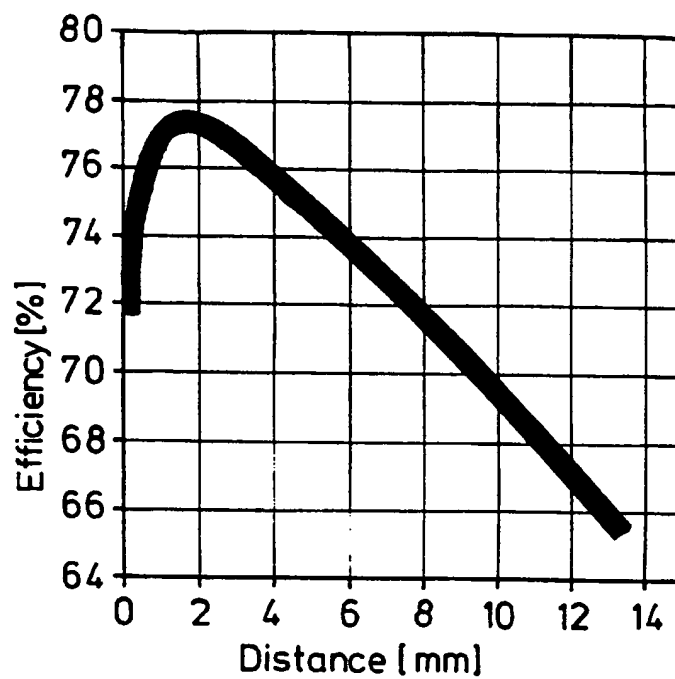


FIG.1

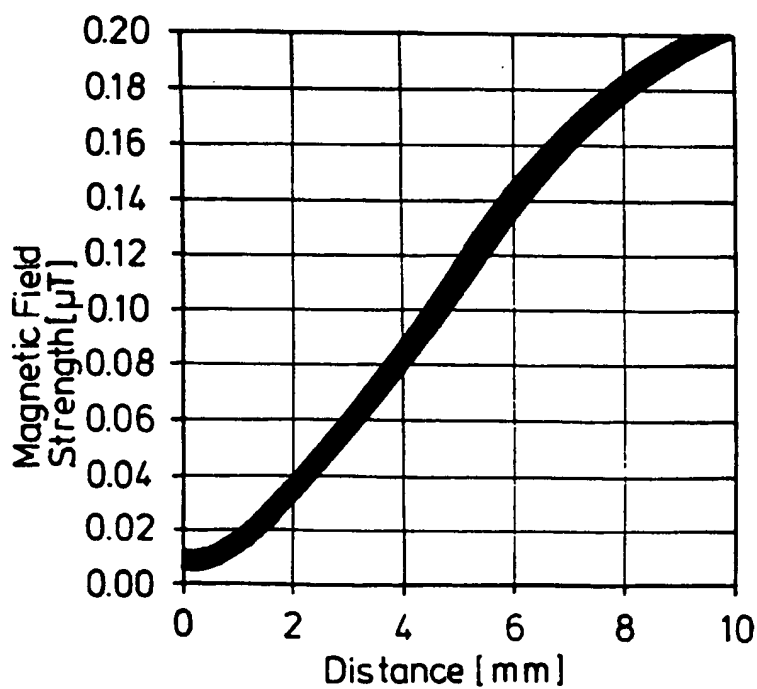


FIG. 2

2/3

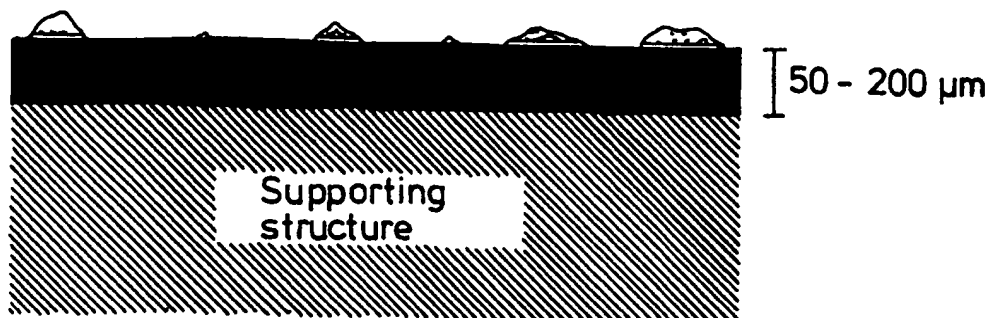
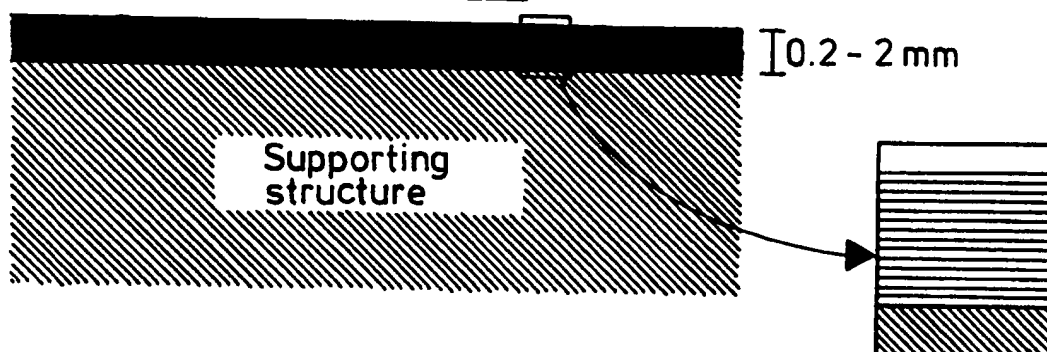
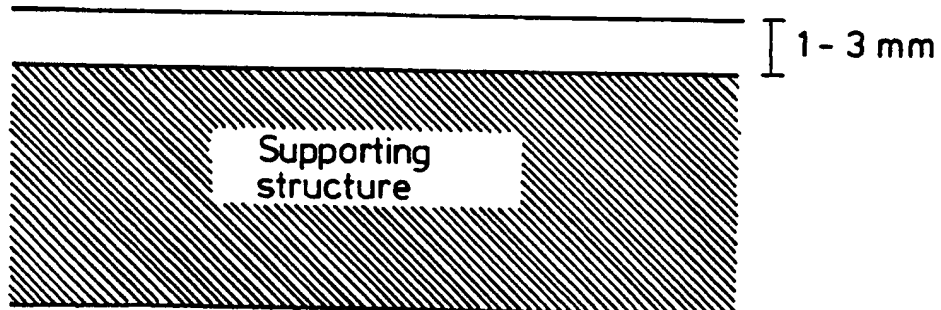
Impregnated plasma sprayingGlass fibre reinforced materialGlass / Glass-ceramic

FIG.3

3/3

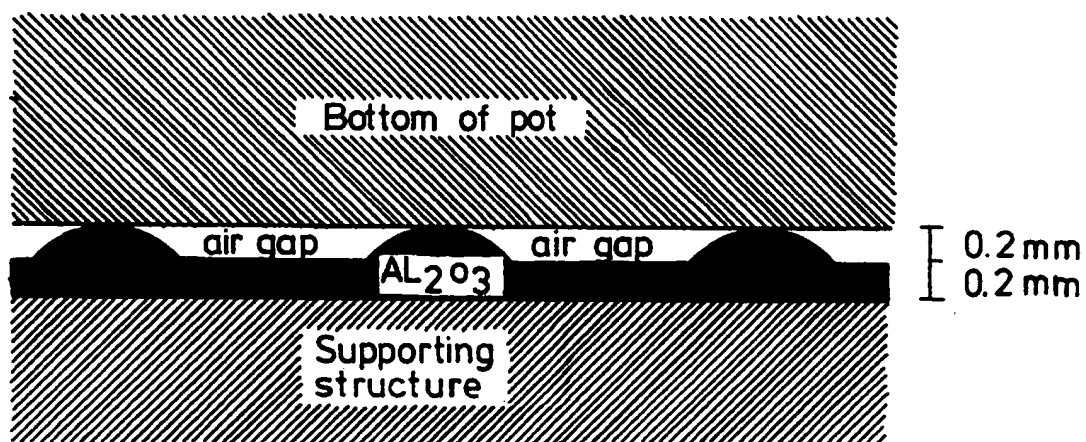


FIG.4

# 1

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/DK 96/00169

### A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H05B 6/12

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9405137 A1 (A/S ERNST VOSS FABRIK), 3 March 1994 (03.03.94)  -----	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

#### \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

17 Sept 1996

Date of mailing of the international search report

19 -09- 1996

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM

Authorized officer

Magnus Westberg

# INTERNATIONAL SEARCH REPORT

Information on patent family members

05/09/96

International application No.

PCT/DK 96/00169

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9405137	03/03/94	AU-A- 4699893	15/03/94
		CA-A- 2143197	03/03/94
		DK-A- 105192	22/04/94
		EP-A- 0657087	14/06/95
		JP-T- 8500464	16/01/96
-----			

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**